PATENT ABSTRACTS OF JAPAN

(11)Publication number : 09-282696

(43)Date of publication of application : 31.10.1997

(51)Int.Cl. G11B 7/125
G11B 7/00

(21)Application number : 08-096508

(22)Date of filing : 18.04.1996

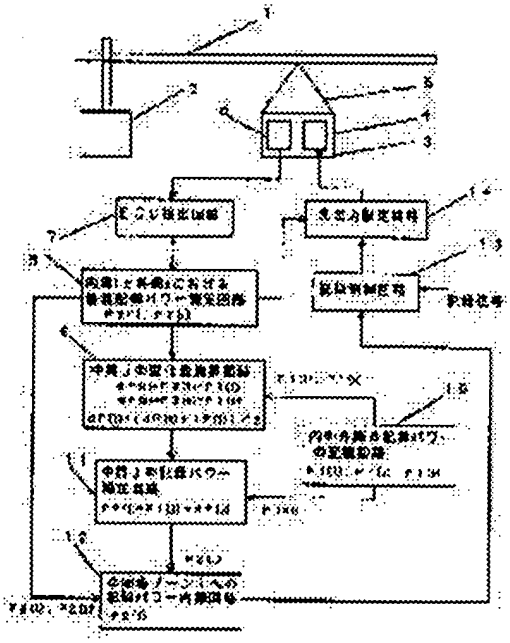
(71)Applicant : MATSUSHITA ELECTRIC IND CO LTD

(72)Inventor : KUBOTA SHINJI
TANJI MASAJI

(54) OPTICAL DISK DEVICE

(57)Abstract:

PROBLEM TO BE SOLVED: To optimize recording power in a user area by measuring optimum recording power in an inner circumference and an outer circumference before recording a signal in the user area and compensating recording power measured in advance in a zone adjacent to a middle circumference and then setting optimum recording power in each zone by a linear approximation.



SOLUTION: This optical disk device is equipped with the following circuits. A storage circuit 10 is for storing optimum power measured in advance at three points of the inner circumference (I), a middle circumference (j) and the outer circumference (n) respectively, and a measuring circuit 8 is for measuring optimum recording power in test areas of the inner circumference and the outer circumference respectively before recording a signal in the user area. A compensation circuit 11 is for compensating the stored recording power of the middle circumference, while an interpolation circuit 12 is for interpolating optimum recording power to the whole zone by using the linear approximation based on the measured optimum recording power of the inner circumference and the outer circumference respectively and the compensated recording power of the middle circumference. Then, the information of the optimum recording power of the interpolation circuit 12 and a recording signal are transmitted by a recording control circuit 13 to an optical output setting circuit 14, so as to perform the recording in the user area.

LEGAL STATUS

[Date of request for examination]	06.10.1999
[Date of sending the examiner's decision of rejection]	
[Kind of final disposal of application other than the examiner's decision of rejection or application converted registration]	
[Date of final disposal for application]	
[Patent number]	3171101
[Date of registration]	23.03.2001
[Number of appeal against examiner's decision of rejection]	
[Date of requesting appeal against examiner's decision of rejection]	
[Date of extinction of right]	

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] Before recording a signal, or this invention's being an optical disk unit which reproduces the signal on the truck recorded on the truck of an optical disk using the optical spot to which the light of semiconductor laser was extracted and recording it on user area, it relates to the optical disk unit which performs a test record by predetermined test truck, sets up the optimal record power, and raises the record reproducing characteristics of the signal in user area.
[0002]
[Description of the Prior Art] In recent years, the rewritable medium of the optical MAG or a phase change is put in practical use with the optical disk unit. The phase change mold which is one of the media of those is performed by heat record according [all records, elimination, or over-writing] to light.
[0003] The light wave form at the time of record of a phase-change optical disk is shown in drawing 7 . In the playback section, light is emitted by the fixed optical output on predetermined DC level. In the record section, two optical outputs, bias power with an elimination function and peak power with a record function, are set up. Over-writing is realized in modulating a record signal between peak power and bias power. Henceforth, in order to simplify explanation, peak power and bias power are collectively divided and explained as record power.
[0004] The set point of record power influences the record reproducing characteristics at the time of recording a signal on an optical disk directly. If the set point of record power is too low, signal amplitude falls, or in the case of a phase-change optical disk, it will erase at the time of over-writing, the remainder will occur in it, and the error rate of a signal will get worse in it. Moreover, if the set point of record power is too large, the error rate of a signal will get worse because pit length becomes large and the resolution of a signal falls. Moreover, if the set point of record power is too large, it is hard to erase a pit and will be in the condition that it erases, the remainder happens, and it cannot erase when the worst. Thus, a setup of record power is not too low, it is not too high, and the optimal point exists. By the record margin, the call, and the usual phase-change optical disk, it becomes about 20 - 35% about the range of the optimum point which can spend by the media of an optical disk, being able to convert into record power.
[0005] Next, the optical disk which changes and sets up a setup of record power by radial is explained. There are some which constitute a zone for every predetermined number of trucks for the purpose of densification in one of the classes of optical disk. The situation of a zone is shown in drawing 8 . Thus, the example of representation of the optical disk which divided the zone is called M-CAV, its disk rotational frequency is fixed from inner circumference to a periphery, and it changes the reference clock of record for every zone, and it is set up so that the pit length of record may become almost equal from inner circumference to a periphery. By such disk, as shown in drawing 8 , it applies to a periphery from inner circumference, linear velocity takes for becoming large, and record sensibility changes for every zone. For this reason, it is necessary to set record power as a different value and to optimize it for every zone. Although the curve of record power is the curve of continuation in the drawing, in the actual optical disk unit, record power is set up for every zone and the curve of record power is stair-like. Since subsequent explanation is also easy, the curve of record power is not stair-like and is drawn with the curve of continuation.
[0006] Next, how to optimize record power is explained using drawing 9 . In drawing 9 , an axis of abscissa shows record power and an axis of ordinate shows the error rate of a signal. TH shows the threshold from which the error rate of a signal serves as usable level. Record power is made to increase gradually from P1 to P4 in the test field of inner circumference other than user area, or a periphery. Although record power does not reach a threshold TH in P3, an error rate is satisfied with P4 of a threshold TH for record power. P4 can be found as a lower limit PBT which becomes more nearly usable [record power] than this. The record power PST to which the predetermined multiplier 1.3 was applied is set up as optimal record power with a predetermined record margin to the usable lower limit PBT. The predetermined multiplier 1.3 is changed by the class of media of an optical disk, the retrieval approach of the design value of the record margin of an optical disk unit, and the usable lower limit PBT, etc. Usually, in order to secure the record margin converted by the record power of an optical disk unit about 20% or more, 1.3 order is chosen as a multiplier.
[0007]
[Problem(s) to be Solved by the Invention] The record sensibility of an optical disk unit differs in inner

circumference and a periphery, and up, the sensibility of the inside periphery of the meantime does not change between inner circumference and peripheries to a linear, either, but it turns in a top or convex sensibility in many cases.

[0008] However, by the optimization approach of the conventional record power, since only the test record in the inner circumference and the peripheries other than user area is made, correction by sensitiveness of the record power in an inside periphery is not carried out. For this reason, in the conventional optical disk unit, although amendment of the record power of inner circumference and a periphery can be performed, it has the fundamental problem that optimization of the record power in the user area of an inside periphery cannot be performed.

[0009] Before this invention's solving such a trouble and recording a signal on user area After amending the record power of the zone near the periphery while measured the optimal record power, measuring beforehand and having memorized on inner circumference and a periphery, by setting up the optimal record power for each zone by linear approximation Record power in user area is optimized and it aims at offering the optical disk unit which improves record reproducing characteristics in all the zones containing user area.

[0010]

[Means for Solving the Problem] In order to attain this purpose, the optical disk unit of this invention A storage means to record the optimal record power beforehand measured by three points of inner circumference, an inside periphery, and a periphery, A measurement means to measure the optimal record power in the test field of an inside-and-outside periphery before recording a signal on user area, An amendment means to amend circumferential record power by the result in a measurement means while memorizing, Linear approximation is carried out from three, the record power of the inside-and-outside periphery from a measurement means, and the record power of the inside periphery from an amendment means, and it has a interpolation means to interpolate the record power of all zones, and a record means to record a signal on the user area of each zone by the record power by which interpolation was carried out.

[0011]

[Embodiment of the Invention] A storage means to memorize three record power of the optimal record power P1 (j) measured in the zone j the optimal record power P1 (n) measured in the optimal record power P1 (1) which measured the optical disk unit of the 1st invention beforehand in the zone 1 of inner circumference, and the zone n of a periphery, and near the inside periphery, A measurement means to measure the optimal record power P2 in the zone 1 of inner circumference (1), and the optimal record power P2 in the periphery zone n (n) before recording a signal on user area, P1 (n) is averaged. variation dP(1) =P2(1)- of the record power in the inner circumference zone 1 -- variation dP(n) =P2(n)- of the record power in P1 (1) and the periphery zone n -- An operation means to calculate the variation of the record power in the zone j near the inside periphery with dP (j) = (dP(n)+dP(1)) / 2, the record power P1 of the zone j near the inside periphery (j) -- P2(j) =P1(j)+ -- with dP (j) and an amendment means to amend While asking with the optimal record power P2 of the zone 1 of inner circumference (1), the optimal record power P2 of the zone n of a periphery (n), and an amendment means, linear approximation is used from three record power of the optimal record power P2 of the zone j near the periphery (j). It has a interpolation means to interpolate the optimal record power P2 to each zone i (i), and a record means to record a signal by user area using the interpolated record power P2 (i).

[0012] By the above-mentioned configuration, at the time of process shipment etc., the optimal record power is measured beforehand in the zone 1 of inner circumference, the zone j near the inside periphery, and the zone n of a periphery, and the result is memorized as P1 (1), P1 (j), and P1 (n) with a storage means. Before recording a signal on user area, the optimal record power P2 in the zone 1 of inner circumference (1) and the optimal record power P2 in the periphery zone n (n) are measured by the measurement means. The difference dP (1) of the memorized record power P1 in the inner circumference zone 1 (1) and the record power P2 (1) measured with the measurement means is searched for. The same variation dP (n) is calculated also in the periphery zone n. the variation of the record power in the zone j near the periphery while an operation means cannot measure by user area -- dP(j) = (dP(n)+dP(1)) / 2, and an average operation -- asking -- an amendment means -- the record power P1 of the zone j near the inside periphery (j) -- P2(j) =P1(j)+ -- it amends with dP (j) and optimizes. A interpolation means interpolates and optimizes the record power P2 to each zone i (i) using linear approximation from three record power of the optimal record power P2 of the zone j near the periphery (j), while asking with the optimal record power P2 of the zone 1 of inner circumference (1), the optimal record power P2 of the zone n of a periphery (n), and the amendment means which were searched for with the

measurement means. A signal is recorded by user area using the optimized record power P2 (i).
[0013] A storage means to memorize the optimal record power P1 (i) which measured the optical disk unit of the 2nd invention to each radial zone i (i is the natural number of 1 to n) which contains user area beforehand, A measurement means to measure the optimal record power P2 in the zone 1 of inner circumference (1), and the optimal record power P2 in the periphery zone n (n) before recording a signal on user area, Variation dP(1) =P2 (1)-P1(1) of the record power in the zone 1 of inner circumference, variation dP(n) =P2(n)- of the record power in the zone n of a periphery -- from P1 (n) An operation means to calculate the variation of the record power P1 in each zone i (i) with dP(i) =dP(1)+(dP(n)-dP(1)) x(i-1)/(n-1), the record power P1 of each zone i (i) -- P3(i) =P1(i)+ -- it has dP (i), an amendment means to amend, and a record means to record a signal by user area using the amended record power P3 (i).
[0014] Thereby, at the time of process shipment etc., the optimal record power is beforehand measured to each zone i from the zone 1 of inner circumference to the zone n of a periphery, and the result is memorized as P1 (i) with a storage means. Before recording a signal on user area, the optimal record power P2 in the zone 1 of inner circumference (1) and the optimal record power P2 in the periphery zone n (n) are measured by the measurement means. The difference dP (1) of the memorized record power P1 in the inner circumference zone 1 (1) and the record power P2 (1) measured with the measurement means is searched for. The same variation dP (n) is calculated also in the periphery zone n. The variation of the record power P1 in each zone i which an operation means cannot measure by user area (i) is calculated with dP(i) =dP(1)+(dP(n)-dP(1)) x(i-1)/(n-1). An amendment means amends the record power P1 of each zone i (i) with P3(i) =P1(i)+dP(i), and optimizes it. A signal is recorded by user area using the optimized record power P3 (i).
[0015] In the optical disk unit of the 1st invention, while asking with the amendment means, the optical disk units of the 3rd invention are the optimal record power P2 of the zone j near the periphery (j), and three record power of the record power P2 of a zone 1 (1), and the record power P2 of Zone n (n) for which it asked with the measurement means, and have added an updating means to update the contents of the storage means.
[0016] Thereby, whenever it optimizes record power, the updating means added in the optical disk unit of the 1st invention updates the contents of the storage means by three record power, the record power P2 of the zone j near the inside periphery (j), the record power P2 of a zone 1 (1), and the record power P2 of Zone n (n). The three optimal record power, the newest inner circumference, an inside periphery, and a periphery, is memorized by the storage means.
[0017] In the optical disk unit of the 2nd invention, the optical disk unit of the 4th invention is the record power P3 of the result amended with the amendment means (i), and has added an updating means to update the contents of the storage means.
[0018] Thereby, whenever it optimizes record power, the updating means added in the optical disk unit of the 2nd invention updates the contents of the storage means by the record power P3 of each zone i (i). The optimal record power P3 of each newest zone i (i) is memorized by the storage means.
[0019] The gestalt of operation of this invention is explained below, referring to a drawing.
(Gestalt 1 of operation) Drawing 1 is the block diagram of the optical disk unit in the gestalt 1 of operation of this invention which amends by the optimal record power which measured the optimal record power measured beforehand in three zones of inner circumference, an inside periphery, and a periphery on inner circumference and a periphery before user area record, and optimizes the record power in each zone.
[0020] The optical disk with which 1 carries out record playback of the signal in drawing 1 at a record medium, the disk motor which 2 makes rotate an optical disk 1 by fixed rotation, the optical head which carries out record playback of the signal on an optical disk 1 at the optical spot to which 3 extracted the light beam, the semiconductor laser whose 4 is the light source of a light beam, the light beam to which 5 is emitted from semiconductor laser 4, and 6 are photodetectors, and the detector which divided the light reflected from the optical disk 1 receives them. The ECC detector which 7 makes a regenerative signal binary and detects an error rate, and 8 are measuring circuits which measure the optimal record power P2 of inner circumference (1), and the optimal record power P2 of a periphery (n) in a test field. n is the natural number which shows the number of zones of a periphery here. 9 is an arithmetic circuit which calculates the variation of the value of the store circuit 10 of record power, and the value measured in the measuring circuit 8.
[0021] variation dP(1) =P2(1)- of the optimal record power P1 of the inner circumference which has memorized the arithmetic circuit 9 in the store circuit 10 (1), and the optimal record power of a difference with the optimal record power P2 (1) measured in the measuring circuit 8 to inner circumference -- P1 (1) is calculated.

moreover, processing that an arithmetic circuit 9 is the same -- a periphery -- carrying out -- variation dP(n) =P2 (n)- of the optimal record power of a periphery -- P1 (n) is calculated. Next, in order that an arithmetic circuit 9 may amend the optimal record power in a periphery while actually being unable to carry out a test record, it equalizes the variation of the record power of inner circumference and a periphery, and calculates the variation of the record power of an inside periphery as dP(j) = (dP(n)+dP(1)) / 2. j expresses the almost middle zone of inner circumference and a periphery, and is the about n/2 natural number here.

[0022] 10 is a store circuit, and when it is in the condition which can perform record of inside peripheries, such as the time of process shipment, it has memorized the optimal record power P1 in the inner circumference measured beforehand, an inside periphery, and a periphery (1), P1 (j), and P1 (n). 11 is an amendment circuit which amends the optimal record power in a periphery while being unable to carry out a test record. The amendment circuit 11 is amended by the variation dP of circumferential record power (j), while memorizing in the store circuit 10 and asking for the circumferential optimal record power P1 (j) in the arithmetic circuit 9. While amending, the optimal circumferential record power is called for by P2(j) =P1(j)+dP(j). 12 is a interpolation circuit, is carrying out linear approximation of the optimal record power P2 of inner circumference (1), the optimal record power P2 of an inside periphery (j), and the optimal record power P2 of a periphery (n), and determines a zone 1 and the record power P2 (i) in each zone i between j and n (i is the natural number from 1 to n). 13 is a record control circuit, tells the optimal information and the optimal record signal of the record power P2 (i) of the interpolation circuit 12 to the latter optical output setting circuit 14, and performs record by user area. 14 is an optical output setting circuit, it sets up the record power of semiconductor laser 4, modulates an optical output by the record signal, and records a signal on an optical disk 1 through the optical head 3. Moreover, when searching for the lower limit PBT which becomes usable [the optical output setting circuit 14 / record power] and optimizing record power, an optical output is made to increase from low record power gradually by control of a measuring circuit 8.

[0023] Actual actuation is explained using the graph of drawing 2 . The axis of abscissa of the graph of drawing 2 has taken the zone from 1 to 9. In order to materialize explanation henceforth, 9 (n= 9) and an inside periphery zone are set to j= 5 for the periphery zone generally shown by n. The optimal record power P1 for the axis of ordinate of the graph of drawing 2 (i) and P2 (i) are taken.

[0024] White round-head'O' shows the optimal record power P1 of three points of the zones 1, 5, and 9 memorized beforehand in the store circuit 10 (1), P1 (5), and P1 (9). A thick continuous line shows what carried out linear interpolation of the optimal record power P1 of three points of zones 1, 5, and 9 (1), P1 (j), and P1 (n).

[0025] The record power of an inside periphery does not change from inner circumference and a periphery to a linear, but has become a convex property so that it may understand by a diagram. For this reason, a setting error will become large if the record power of an inside periphery is simply taken out from the average of the record power, inner circumference and a periphery, of two points.

[0026] Before recording on user area, the optimal record power P2 (1) for which the measuring circuit 8 asked on inner circumference and a periphery, and P2 (n) are plotted by '**'. An arithmetic circuit 9 asks for variation dP(1) =P2(1)-P1(1) of the record power in inner circumference. Thereby, the variation of the record sensibility in inner circumference is grasped. next, the arithmetic circuit 9 -- variation dP(n) =P2(n)- of the record power in a periphery -- P1 (n) is calculated. Thereby, the variation of the record sensibility in a periphery is grasped. From the variation of the record power in the inner circumference and the periphery which were actually measured, the variation dP of the record power in an inside periphery (j) is calculated, without performing record actuation. An arithmetic circuit 9 equalizes the variation dP of inner circumference (1), and the variation dP of a periphery (n), and calculates variation dP(j) = (dP(n)+dP(1)) / 2 in an inside periphery. the optimal record power P1 (j) of a periphery while calculating and having memorized from the circumferential variation dP (j) in the store circuit -- P2(j) =P1(j)+ -- it is amended as dP (j) and shown to drawing by '**'. It is the optimal record power P2 (i) of the zone between the zones 1, 5, and 9 determined by interpolation from the optimal record power (1), inner circumference, an inside periphery, and a periphery, P2 of three points, P2 (j), and P2 (n) which a dotted line shows by a diagram.

[0027] As explained above, before recording a signal on user area, the optimal record power (1), inner circumference and a periphery, P2 of two points and P2 (n) are measured. By setting up the optimal record power P2 for each zone (i) by linear approximation, after amending the record power P1 of the zone near the periphery (j) to P2 (j) while measuring beforehand and having memorized Record power in the user area of an

inside periphery can be optimized, and record reproducing characteristics can be improved in all the zones containing user area.

[0028] (Gestalt 2 of operation) Drawing 3 is the block diagram of the optical disk unit in the operation gestalt 2 of this invention which amends by the optimal record power which measured the optimal record power measured beforehand in each zone i (i is the natural number from 1 to n) on inner circumference and a periphery before user area record, and optimizes the record power in each zone. The configuration which carried out the current update is explained to drawing 1 which is the configuration of the gestalt 1 of operation.

[0029] 20 is a store circuit, and when it is in the condition which can perform record of inside peripheries, such as the time of process shipment, it has memorized the optimal record power P1 in each zone i from the inner circumference measured beforehand to a periphery (i). variation dP(1) =P2(1)- of the optimal record power P1 of the inner circumference which 21 is an arithmetic circuit and has been memorized in the store circuit 20 (1), and the optimal record power of a difference with the optimal record power P2 (1) measured in the measuring circuit 8 to inner circumference -- P1 (1) is calculated. moreover, the same processing as an arithmetic circuit 21 -- a periphery -- carrying out -- variation dP(n) =P2(n)- of the optimal record power of a periphery -- P1 (n) is calculated. Next, an arithmetic circuit 21 calculates the variation of the record power in each zone i as dP(i) =dP (1)+(dP(n)-dP(1)) x(i-1)/(n-1) in order to amend the optimal record power in each zone i which cannot actually carry out a test record. 22 is the amendment circuit of the record power of each zone i, and amends the optimal record power P1 (i) memorized in the store circuit 20 by the variation dP of the record power for which it asked in the arithmetic circuit 21 (i). The optimal record power of each amended zone i is called for by P3(i) =P1(i) +dP(i). In order that linear approximation may not use for calculating the optimum value of each zone i unlike the gestalt 1 of previous operation, the setting precision of the optimal record power is improved. 23 is a record control circuit, tells the optimal information and the optimal record signal of the record power P3 (i) of the amendment circuit 22 to the latter optical output setting circuit 14, and performs record by user area.

[0030] Next, actual actuation is explained using the graph of drawing 4 . The axis of abscissa of the graph of drawing 4 has taken the zone from 1 to 9. In order to simplify explanation henceforth, 9 and an inside periphery zone are set to j= 5 for the periphery zone generally shown by n. The optimal record power P1 for the axis of ordinate of the graph of drawing 4 (i) and P2 (i) are taken.

[0031] White round-head [of nine pieces]'O' shows the optimal record power P1 of each zone i memorized beforehand in the store circuit 20 (i) to P1(1) -P1(9). Three record power of inner circumference, an inside periphery, and a periphery was memorized, and the linear approximation by interpolation was required of the gestalt 1 of previous operation in other zones. With the gestalt of this operation, as a continuous line shows, the record power P1 in all the zones i (i) is memorized, the linear approximation of record power is unnecessary and setting precision is improved. Inside periphery sensibility is a convex up and down, or even if it is a secondary curve, the setting precision of record power is maintained.

[0032] Before recording on user area, the optimal record power P2 (1) for which the measuring circuit 8 asked on inner circumference and a periphery, and P2 (9) are plotted by '**'. an arithmetic circuit 21 -- variation dP(1) =P2(1)- of the record power in inner circumference -- variation dP(9) =P2(9)- of the record power in P1 (1) and a periphery -- P1 (9) is calculated. From the variation of the record power in the inner circumference and the periphery which were actually measured, the variation dP of the record power in each zone i (i) is calculated, without performing record actuation. An arithmetic circuit 21 calculates variation dP(i) =dP(1)+(dP(n)-dP(1)) x (i-1)/(n-1) in each zone i from the variation dP of inner circumference (1), and the variation dP of a periphery (9). the optimal record power P1 (i) of each zone i memorized from the calculated variation dP (i) in the store circuit 20 -- P3(i) =P1(i)+ -- it is amended as dP (i) and shown to drawing by '**'.

[0033] As explained above, before recording a signal on user area, the optimal record power (1), inner circumference and a periphery, P2 of two points and P2 (n) are measured. By amending the record power P1 of each zone i which measured beforehand and has been memorized (i) to P3 (i) Interpolation by linear approximation cannot be used but record reproducing characteristics can be improved in all the zones that optimize record power in the user area of all the zones i with high precision, and contain user area.

[0034] (Gestalt 3 of operation) Drawing 5 is amended by the optimal record power which measured the record power which measured beforehand and has been memorized in three zones of inner circumference, an inside periphery, and a periphery on inner circumference and a periphery before user area record, and is the block diagram of the optical disk unit in the gestalt 3 of operation of this invention to update.

[0035] The configuration which carried out the current update is explained to drawing 1 which is the

configuration of the gestalt 1 of operation. 30 is an update circuit which updates the data of the record power memorized in the store circuit 10. Before recording by user area, after calculating the optimal record power P2 (1) and P2 (n) on inner circumference and a periphery, the record power of an inside periphery is amended to P2 (j). The optimal record power P2 of each zone i (i) is interpolated and determined from three record power P2 (1), P2 (j), and P2 (n). A signal is recorded by user area using the optimized record power P2 (i) for which it asked by interpolation. Update circuits 30 are the optimal record power P2 of inner circumference, an inside periphery, and a periphery (1), P2 (j), and P2 (n), and update the data P1 (1) memorized in the store circuit 10, P1 (j), and P1 (n), respectively.

[0036] As explained above, whenever the contents memorized in a store circuit 10 perform optimization of the record power instead of the record power determined at the time of process shipment, they are updated by the newest record power with the gestalt of this operation. When the optical disk unit carries out aging, the optimal record power has a possibility of separating quite greatly from the record power at the time of process shipment. If the contents of the store circuit 10 are updated to the newest record power, in the case of record correction by sensitiveness, the amount of gaps of the record power remembered to be the optimal power is small, it ends, and the error by the operation and the processing time can be improved.

[0037] (Gestalt 4 of operation) Drawing 6 is amended by the optimal record power which measured the record power which measured beforehand and has been memorized in each zone i on inner circumference and a periphery before user area record, and is the block diagram of the optical disk unit in the gestalt 4 of operation of this invention to update.

[0038] The configuration which carried out the current update is explained to drawing 3 which is the configuration of the gestalt 2 of operation. 40 is an update circuit which updates the data of the record power memorized in the store circuit 20. Before recording by user area, after calculating the optimal record power P2 (1) and P2 (n) on inner circumference and a periphery, the record power of each zone i is amended to P2 (i). A signal is recorded by user area using the optimized record power P2 (i) for which it amended and asked. An update circuit 40 is the optimal record power P2 in each zone i (i), and updates the data P1 (i) memorized in the store circuit 20.

[0039] As explained above, whenever the contents memorized in a store circuit 20 perform optimization of the record power instead of the record power determined at the time of process shipment, with the gestalt of this operation, they are updated by the newest record power to each zone i. When the optical disk unit carries out aging, the optimal record power has a possibility of separating quite greatly from the record power at the time of process shipment, but since the contents of the store circuit 20 are updated to the newest record power in each zone i, in the case of record correction by sensitiveness, the amount of gaps of the record power remembered to be the optimal power is small, it ends, and the error by the operation and the processing time can be improved in each zone i.

[0040] In addition, although divided two kinds of optical outputs, bias power and peak power, and the gestalt of operation of this invention did not explain them as record power, in the case of a phase-change optical disk, it is necessary to set up two kinds of optical outputs, bias power and peak power, as record power at least. Also in this case, it cannot be overemphasized that this invention is applicable.

[0041] Moreover, before recording on user area, it may not surely perform amending and optimizing record power, or it may be performed at the time of the power-source standup of an optical disk unit, and it may be performed by the time period predetermined in the condition that the power source was turned on.

[0042] Furthermore, although all optimization of record power was processed with the configuration of hardware in the gestalt of operation of this invention, all arithmetic part may be processed by software.

[0043]

[Effect of the Invention] Record power in user area can be optimized as mentioned above by setting up the optimal record power for each zone by linear approximation, after amending the record power of the zone near the periphery while measured the optimal record power, inner circumference and a periphery, of two points, measuring beforehand and having memorized before recording a signal on user area in the 1st invention, and record reproducing characteristics can be improved in all the zones containing user area.

[0044] Moreover, in the 2nd invention, before recording a signal on user area, by amending the record power of each zone i which measured the optimal record power, inner circumference and a periphery, of two points, measured beforehand, and has been memorized, interpolation by linear approximation cannot be used but record reproducing characteristics can be improved in all the zones that optimize record power in the user area of all

the zones i with high precision, and contain user area.

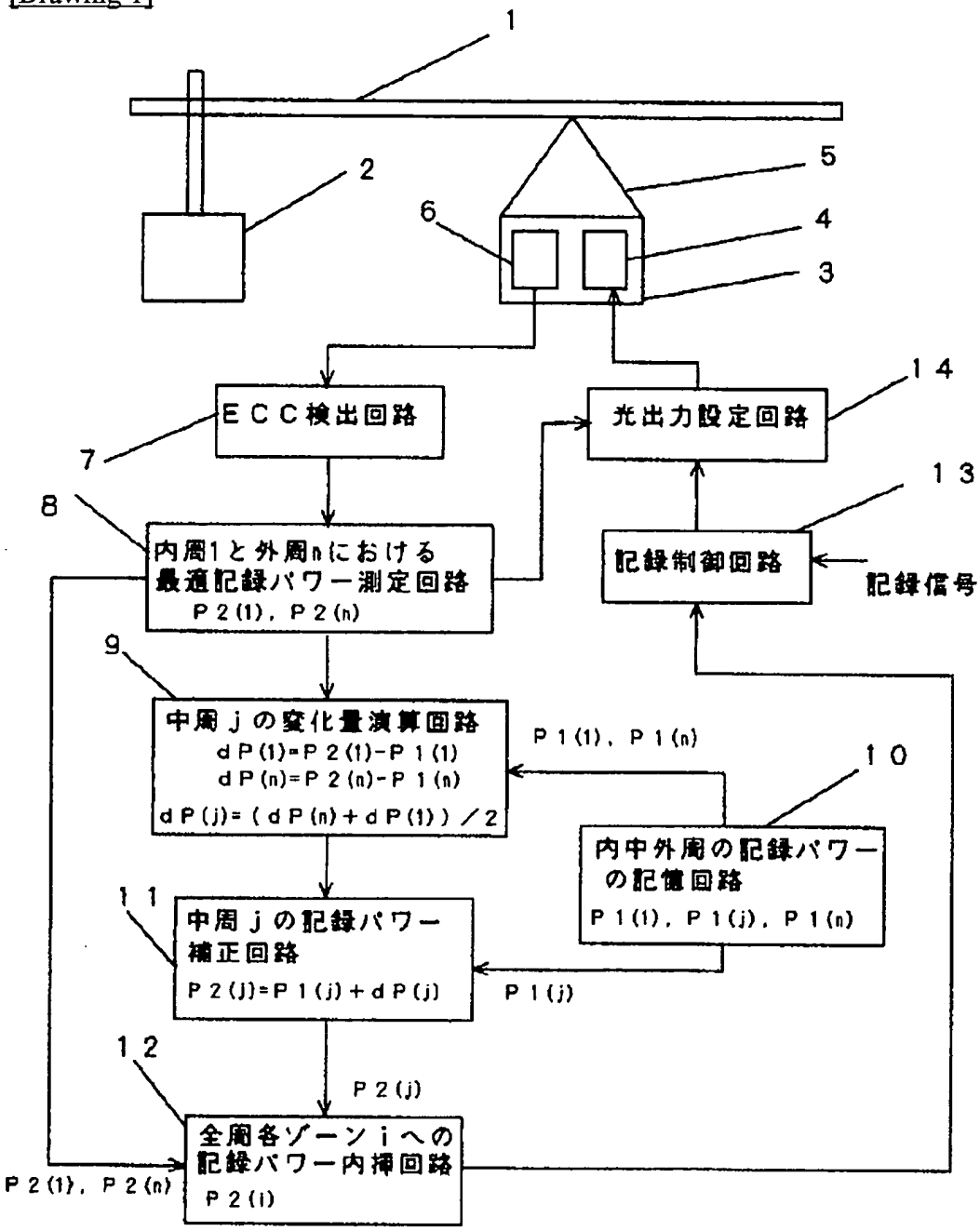
[0045] Moreover, in the 3rd invention, whenever the contents memorized in a store circuit perform optimization of the record power instead of the record power determined at the time of process shipment, even when are updated by the newest record power and an optical disk unit carries out aging, in the case of record correction by sensitiveness, the amount of gaps of the record power remembered to be the optimal record power is small, and the error by the operation and the processing time can be improved.

[0046] Moreover, whenever the contents memorized in a store circuit perform optimization of the record power instead of the record power determined at the time of process shipment, when they are updated by the newest record power to each zone i, the amount of gaps of the record power remembered to be the optimal power is small, it ends, and the error by the operation and the processing time can improve in the 4th invention in each zone i in the case of record correction by sensitiveness.

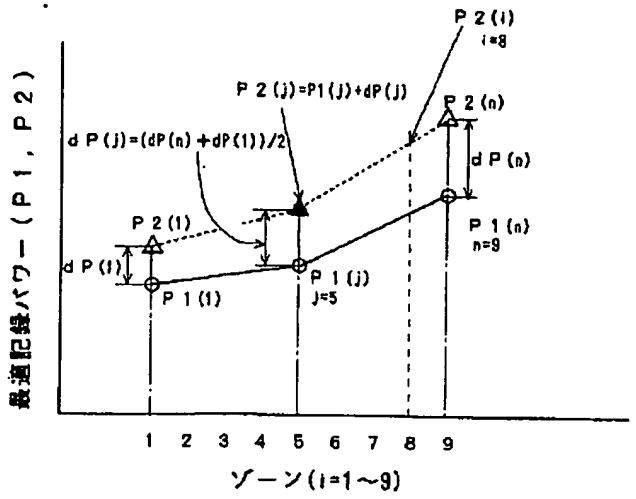
[Translation done.]

DRAWINGS

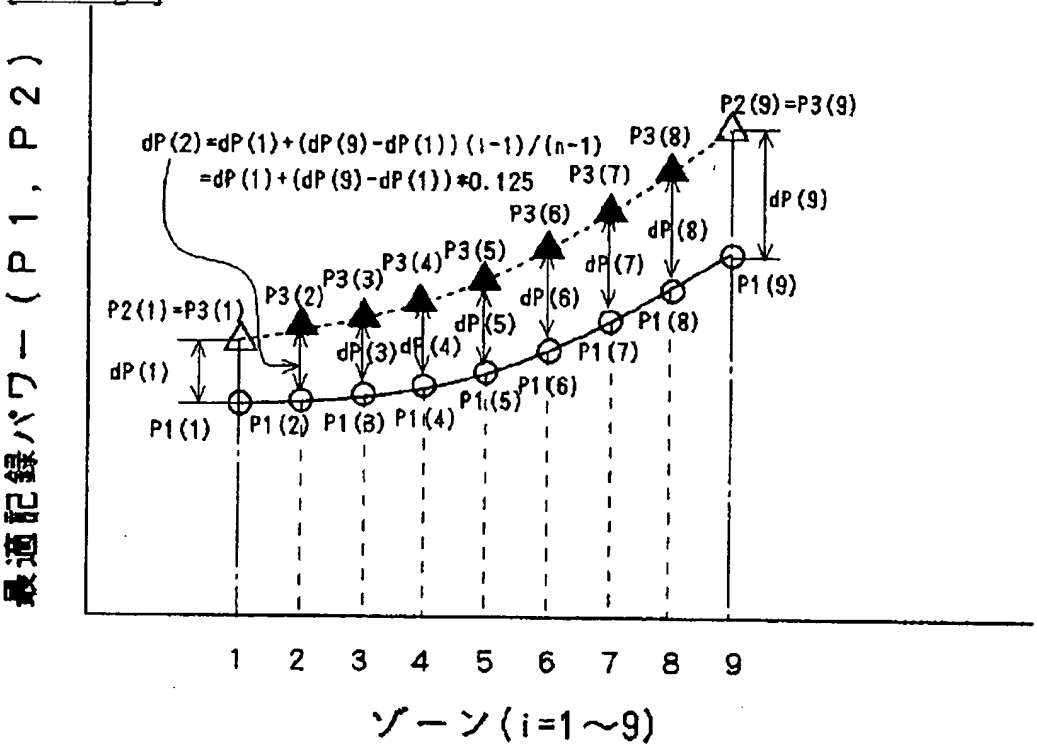
[Drawing 1]



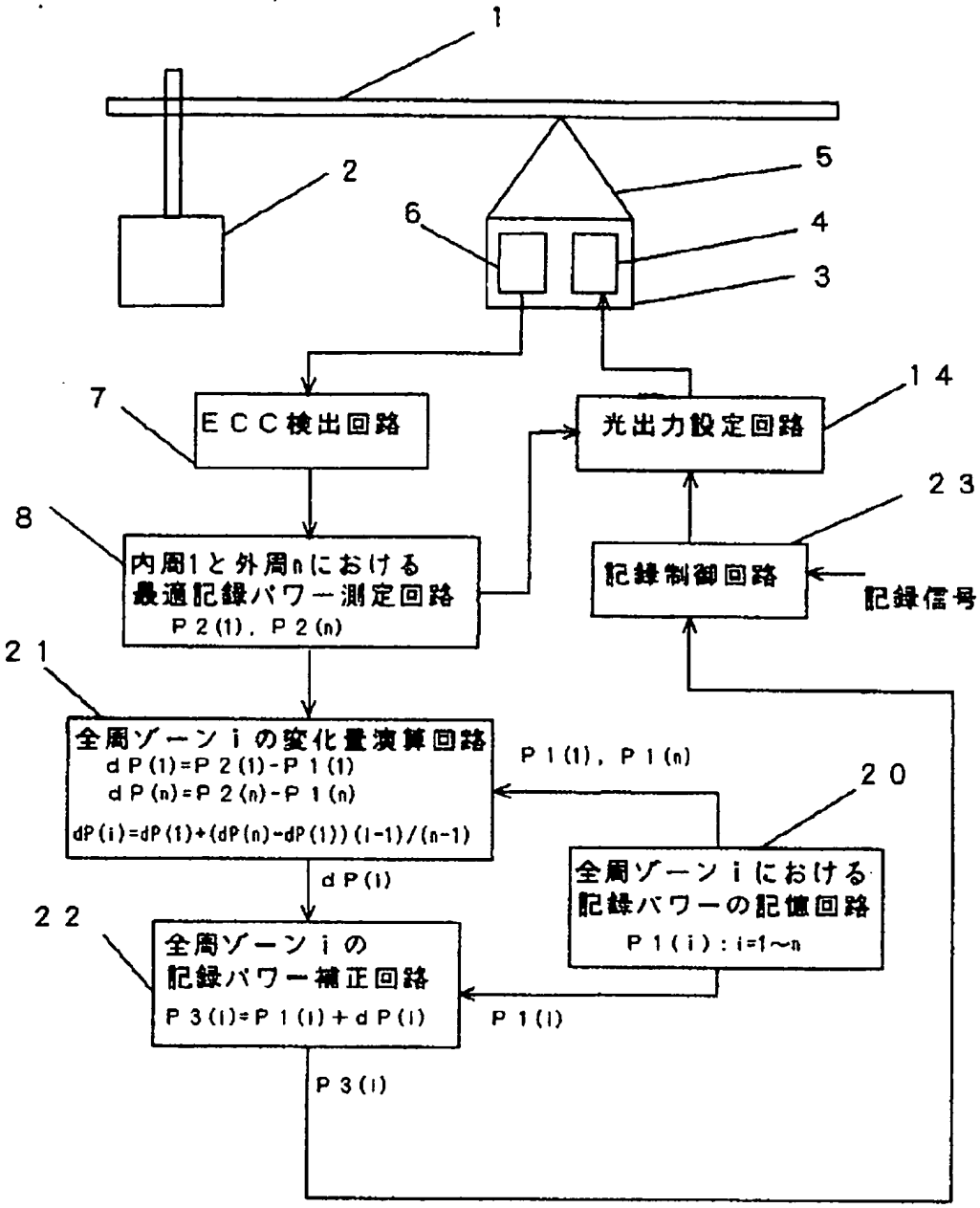
[Drawing 2]



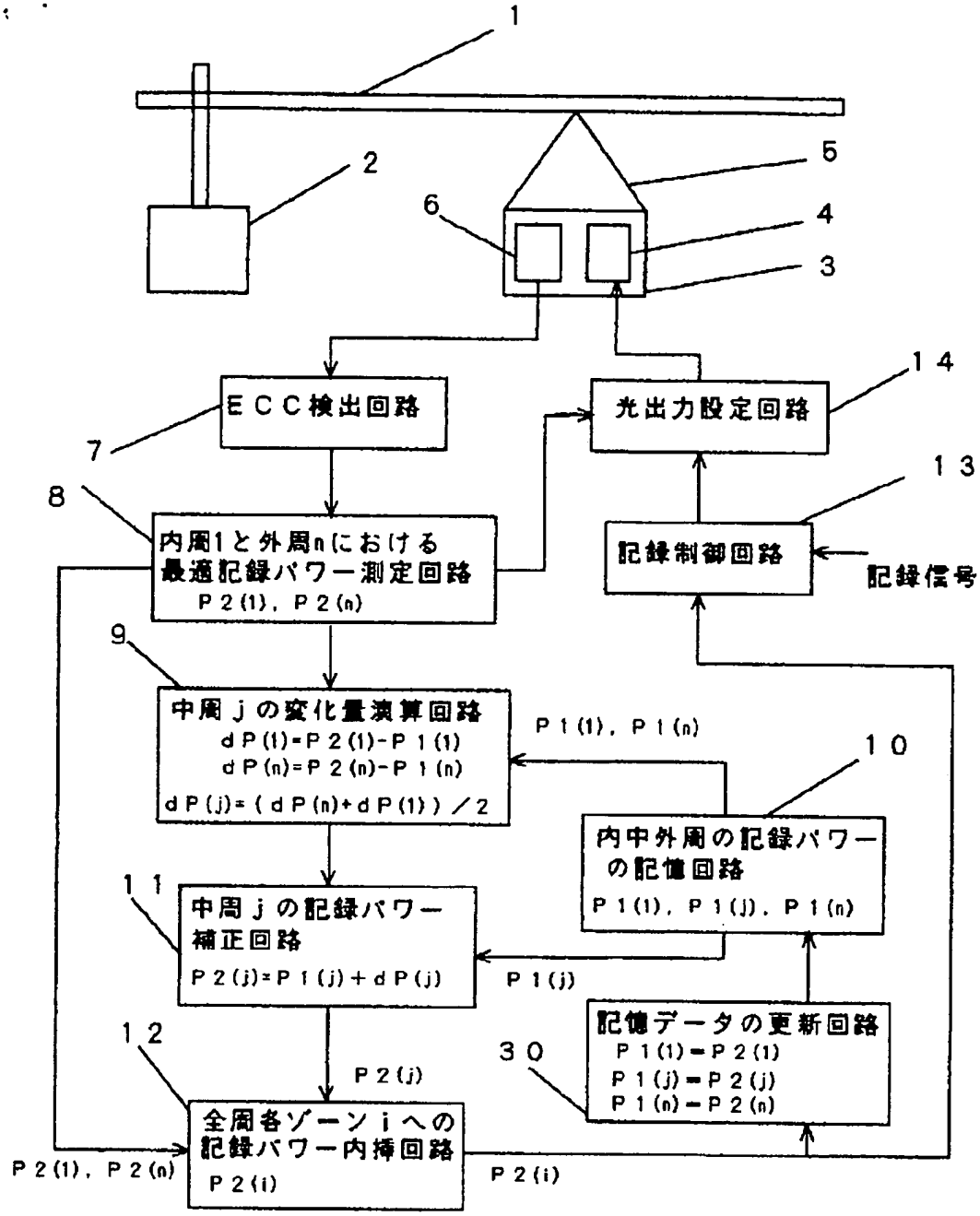
[Drawing 4]



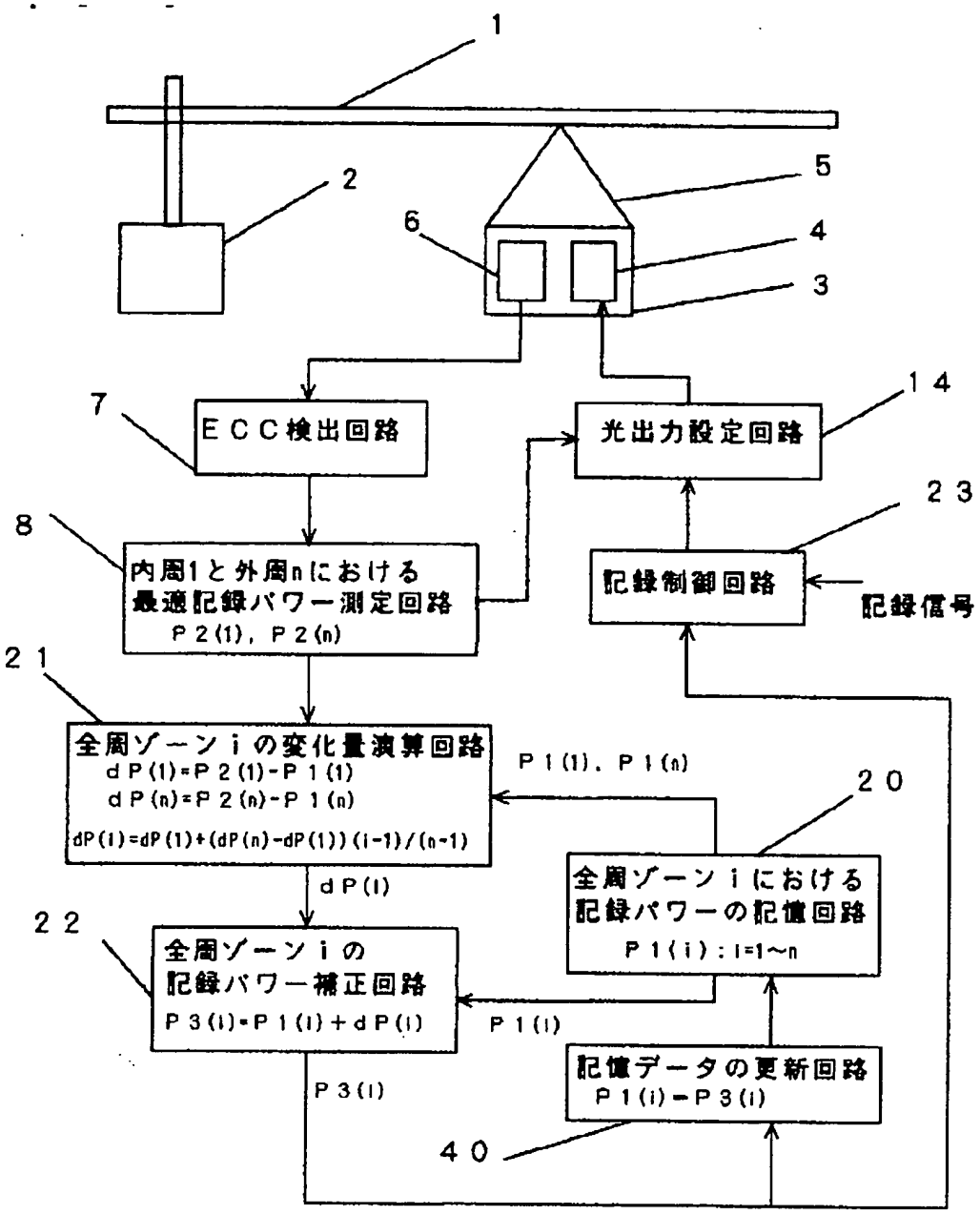
[Drawing 3]


1
2
5
6
4
3
7
ＥＣＣ検出回路
１４
光出力設定回路
２３
8
内周1と外周nにおける
最適記録パワー測定回路
Ｐ２(1)，Ｐ２(n)
記録制御回路
記録信号
２１
全周ゾーンｉの変化量演算回路
ｄＰ(1)=Ｐ２(1)-Ｐ１(1)
ｄＰ(n)=Ｐ２(n)-Ｐ１(n)
dP(i)=dP(1)+(dP(n)-dP(1))(i-1)/(n-1)
Ｐ１(1)，Ｐ１(n)
２０
ｄＰ(i)
２２
全周ゾーンｉの
記録パワー補正回路
Ｐ３(i)=Ｐ１(i)＋ｄＰ(i)
全周ゾーンｉにおける
記録パワーの記憶回路
Ｐ１(ｉ)：i=1～n
Ｐ１(i)
Ｐ３(i)

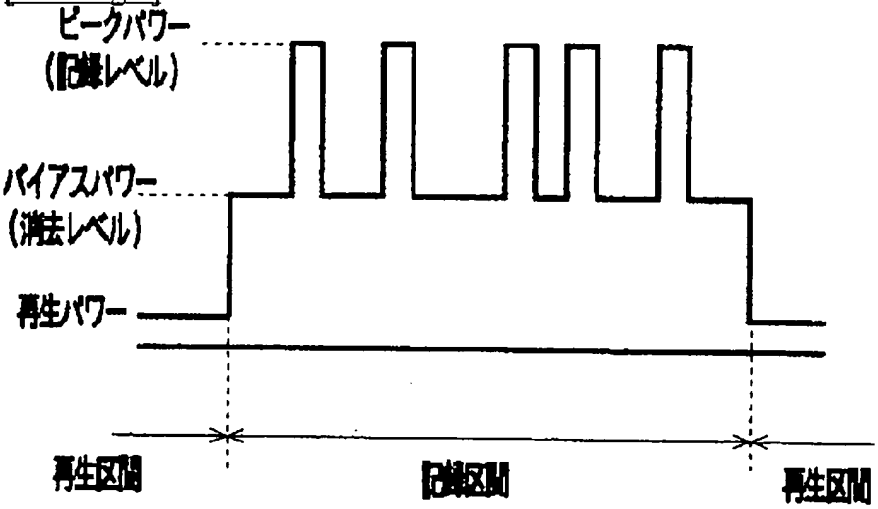
[Drawing 5]


1
2
5
6
4
3
ＥＣＣ検出回路
14
光出力設定回路
7
8
内周1と外周nにおける
最適記録パワー測定回路
P 2 (1)，P 2 (n)
13
記録制御回路
記録信号
9
中周ｊの変化量演算回路
d P (1) = P 2 (1) - P 1 (1)
d P (n) = P 2 (n) - P 1 (n)
d P (j) = (d P (n) + d P (1)) ／2
P 1 (1)，P 1 (n)
10
内中外周の記録パワー
の記憶回路
P 1 (1)，P 1 (j)，P 1 (n)
11
中周ｊの記録パワー
補正回路
P 2 (j) = P 1 (j) + d P (j)
P 1 (j)
12
P 2 (j)
30
記憶データの更新回路
P 1 (1) = P 2 (1)
P 1 (j) = P 2 (j)
P 1 (n) = P 2 (n)
全周各ゾーンｉへの
記録パワー内挿回路
P 2 (i)
P 2 (1)，P 2 (n)
P 2 (i)

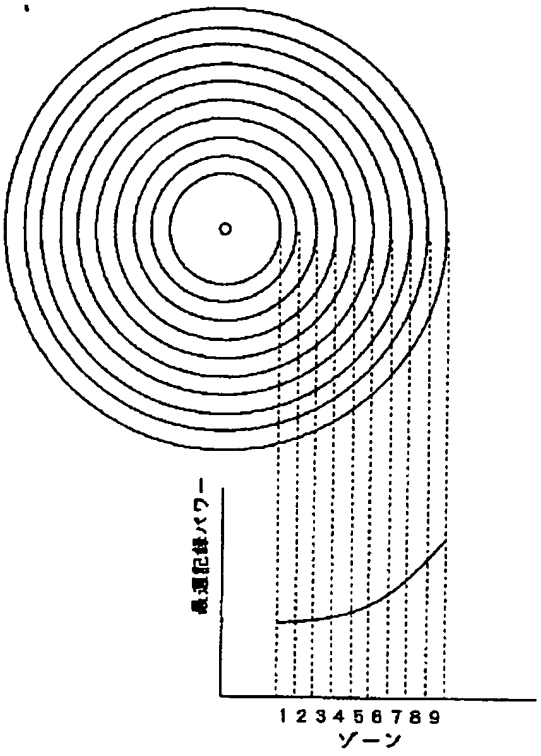
[Drawing 6]



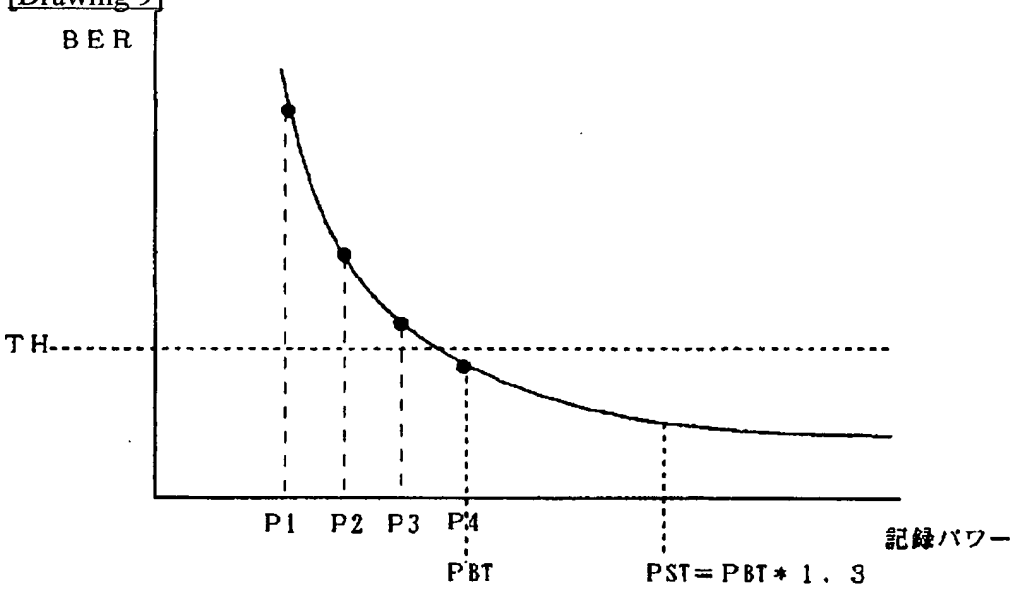
[Drawing 7]



[Drawing 8]



[Drawing 9]



[Translation done.]